

## THE FUNDAMENTAL UNIT OF LIFE

### 1. Who discovered cell and what are the propositions of the 'Cell Theory'?

Robert Hooke in 1665, discovered cell. He observed a thin slice of cork and found that it contained a large number of little boxes or compartments which he named as 'cells' meaning 'hollow spaces'.

The German biologists – M J Schleiden and Theodore Schwann formulated the Cell Theory – which states that

- a) All organisms are composed of cells or cell products.
- b) The cell is the structural and functional unit of life
- c) Cells can arise only from pre-existing cells.

### 2. Why is a cell considered to be a structural and functional unit of life?

All living organisms are made up of cells. Organisms as tiny as a single celled amoeba, paramecium etc. and multicellular organisms as huge as a whale are all made up of the basic unit called cell. Therefore, cell can be considered as the structural unit of all living organisms. Cell is also considered a functional unit because, all organisms, whether unicellular or multicellular carry out certain basic life functions such as feeding, digestion, assimilation, excretion, respiration, and cell division. All activities of a living organism are due to the consolidated and coordinated functioning of cells in the body of the organism. Hence, cells are considered functional unit of life. Therefore cells are considered as both structural and functional unit of life.

### 2. What are prokaryotes? Give examples.

The primitive cells which lack a definite nucleus are called prokaryotes. The DNA or nuclear material of these prokaryotes is condensed and dense, but not enclosed in a nuclear membrane. This structure is called the **nucleoid**. Eg. Bacteria, Blue green algae.

### 3. What are eukaryotes? Give examples.

These are cells or organisms which have a well defined nucleus. Their genetic material is enclosed within a nuclear membrane. Such cells are called eukaryotic cells. Eg. Cells of all multicellular organisms

### 4. Differentiate between a prokaryotic and eukaryotic cell.

	Prokaryotic cell	Eukaryotic cell
1	It is generally small ( 1- 10 $\mu\text{m}$ )	It is comparatively larger ( 5 -100 $\mu\text{m}$ ) in size
2	It lacks a well organized nucleus and its nuclear material is not surrounded by a nuclear membrane.	It contains a well organized nucleus as its nuclear material is enclosed in a nuclear membrane.
3	Nucleolus is absent	Nucleolus is present inside the nucleus.
4	It has a single chromosome	It has more than one chromosome.
5	It lacks the membrane bound cell organelles	It has membrane bound cell organelles.
6	Cell division occurs by fission or budding, which is a simple form of cell division.	Cell division takes place by elaborate methods of mitosis and meiosis.

### 5. Describe the structure of the Cell membrane or Plasma membrane. What are its functions?

This is the outermost covering of the cell that separates the contents of the cell from its external environment. Plasma membrane is a living, thin, flexible, selectively permeable membrane made up of lipids and proteins (lipoproteinous) and is present both in plant and animal cells.

#### Functions:

- a) It gives definite shape to the cell.
- b) It separates the contents of a cell from its surrounding medium.
- c) It provides a mechanical barrier for the protection of the internal contents of the cell.
- d) It selectively regulates the entry and exit of substances into and out of the cell and hence it is called selectively permeable membrane.
- e) It allows the flow of materials and information between different organelles of the same cell and that of adjacent cells.

### 6. Differentiate between Diffusion and Osmosis.

	Diffusion	Osmosis
1	Diffusion is defined as the spontaneous movement of molecules of any substance from a region of higher concentration to a region of lower concentration.	Osmosis is the movement of water molecules from a region of higher concentration to a region of lower concentration through a semi permeable membrane.
2	diffusion can take place in any medium	Osmosis occurs only in liquid medium
3	It does not require a semi permeable membrane	It requires a semi permeable membrane.
4	The diffusing molecules could be that of solids, liquids or gases	It involves movement of solvent molecules only.

### 7. Define hypotonic, isotonic and hypertonic solutions. How does a living cell respond when put in these solutions?

**Hypotonic solution:** If the medium surrounding the cell has a higher water concentration than the cell, that is, if the solution is very dilute, the cell will gain water by osmosis, and swell up. The entry of water into the cell is called **endosmosis**. Such a dilute solution is called hypotonic solution.

**Isotonic solution:** if the medium has exactly the same water concentration as the cell, there will be no movement of water molecules into or out of the cell across the cell membrane. Such a solution is called isotonic solution.

**Hypertonic solution:** if the medium has a lower concentration of water molecules than the cell, that is, if the solution is concentrated, the cell will lose water by osmosis. Thus, movement of water molecules out of the cell is called **exosmosis**. Such a solution is called hypertonic solution. Exosmosis in plant cells result in shrinkage of the protoplasm away from the cell wall. This is called **Plasmolysis**.

## 8. What is the importance of diffusion?

Diffusion brings about:

1. Exchange of gases during respiration. CO<sub>2</sub> and O<sub>2</sub> move into and out of the cells.
2. The uniform distribution of molecules within the cell cytoplasm.
3. Transpiration – loss of water vapor from plant surface.
4. Spreading fragrance from flowers to facilitate pollination.

## 9. What is the importance of Osmosis?

1. Unicellular fresh water organisms absorb water through osmosis
2. Land plants absorb water from soil by their roots by osmosis
3. Turgidity of the cell is maintained due to osmosis.

## 10. What is endocytosis?

The flexibility of the cell membrane enables the cell to engulf complex food and other materials from the external environment. Such process is known as **endocytosis**. Many unicellular organisms such as amoeba obtain their food by the process of endocytosis.

## 11. Structure and function of the different cell organelles:

**a. Cell wall:** Plant cells have a thick, rigid, outer protective covering called the cell wall, made of cellulose. It lies outside the plasma membrane and is permeable. It is the non-living part of the cell.

### Functions:

1. The cell wall provides rigidity and shape to the plant cell.
2. It protects the protoplasm against mechanical injury and prevents desiccation of the cell.
3. It counteracts the osmotic pressure and prevents the plant cells from bursting due to endosmosis.
4. It helps the plant cells to withstand drastic changes in the surrounding medium than animal cells.

**b. Protoplasm:** is the viscous, colorless, transparent, gel like material present in the cell. It is the life giving substance of the cell. A major portion of it is water with dissolved organic molecules such as proteins, fats, carbohydrates, nucleic acids etc. it is commonly called the '**physical basis of life**'.

**c. Cytoplasm:** is the viscous, translucent, homogeneous, semi fluid mass of the protoplasm excluding the nucleus and vacuoles. It contains all the vital nutrients such as carbohydrates, lipids, proteins, amino acids, minerals and water. Different cell organelles are embedded within the cytoplasm.

### Functions:

1. It is the seat of cellular metabolism. Synthesis of different types of biomolecules such as proteins, nucleic acids fatty acids etc take place in the cytoplasm.
2. Cytoplasm helps in the intra cellular distribution of enzymes, nutrients and biomolecules within the cell
3. It helps in the exchange of materials between different cell organelles.
4. Glycolysis – breakdown of glucose molecule during cell respiration starts in the cytoplasm.

**d. Nucleus:** it is the largest cell structure, dense, spherical or oval, usually located in the center of the cell. Nucleus has the following important parts-

**Nuclear membrane:** double layered membrane that separates nucleus from the cytoplasm. It has several pores called nuclear pores which allow the transfer of materials in and out of the nucleus into cytoplasm.

**Nucleoplasm:** is the homogeneous, granular dense fluid present inside the nucleus, in which chromatin and nucleolus are suspended.

**Chromatin material:** consists of long coiled network of thread like structures, made of deoxyribonucleic acid (DNA). They are responsible for storing and transmitting hereditary information from one generation to another. During cell division, the chromatin material condenses into thick cord like structures called **chromosomes**. The chromosomes contain segments called **genes** and each gene is responsible for one hereditary character of the organism.

**Nucleolus:** is a spherical granular body containing RNA (ribonucleic acid) and proteins. RNA is helpful in protein synthesis.

**Functions:**

1. Nucleus contains all the genetic information required for the growth, development, reproduction, metabolism and behavior of the organism.
2. It controls cell metabolism and other activities of the cell, hence it is called the 'master of the cell'.

**e. Endoplasmic Reticulum:** is a large network of membrane bound tubes and sheets spread throughout the cytoplasm connecting the cell membrane and the nuclear membrane. Endoplasmic Reticulum is of two types –

**Rough Endoplasmic Reticulum – RER** – which appears rough due to the presence of minute granular ribosomes attached to the surface.

**Smooth Endoplasmic Reticulum – SER** – which appears smooth due to the absence of ribosomes.

**Functions:**

1. ER provides a structural framework to the cell and gives support to the cytoplasmic matrix.
2. It provides a large surface area inside the cell for various physiological activities.
3. RER serves as a channel for the transport of materials synthesized (esp. proteins) between various regions of the cytoplasm and between cytoplasm and nucleus.
4. Smooth ER helps in the synthesis of lipids, steroid hormones in testes and ovaries, and detoxification of harmful substances in the liver cells. It also carries out membrane biosynthesis in the liver cells.

**f. Ribosome:** are small granular structures made up of ribose nucleic acid and proteins. They occur free in the cytoplasm as well as attached to the outer surface of the rough ER. They are found in both prokaryotic and eukaryotic cells.

They are the sites of protein synthesis and therefore called the protein factories of cells.

**g. Golgi Apparatus:** is found in animal cells. Golgi apparatus consists of a number of membrane bound, fluid filled, flattened sacs - stacked one above the other called the cisternae. Large spherical vacuoles and fluid filled vesicles surround the cisternae. It has a concave forming surface. It is a single unit lying closely associated with the ER and nucleus. In plant cells, are called dictyosomes.

### Functions:

1. It is secretory organelle; Secretory proteins and lipids (enzymes and hormones) are packaged and released on the surface by exocytosis.
2. It is the assembly area for storage, modification and packaging of products in vesicles.
3. Formation of complex sugars from simple sugar and its storage as glycogen in the liver cells is done by Golgi apparatus.
4. It is involved in the formation of lysosomes.

**h. Lysosomes:** are membrane bound vesicles containing various types of powerful digestive enzymes. They are produced by the joint activity of RER and Golgi apparatus. Enzymes made by the RER are packed securely by Golgi apparatus. They are involved in the intracellular digestion of foreign material as well as microbes and therefore called digestive bags. If ruptured, the enzymes of the lysosome can digest the entire cell causing death of the cell – hence called **the demolition squads**.

### Functions:

1. They are involved in autolysis or self digestion of cells which get aged, diseased or injured. Hence they are called the '**suicide bags**' of the cell.
2. Lysosomes are involved in intracellular digestion of food ingested by endocytosis.
3. Lysosomes of the WBC's destroy pathogens and take part in the natural defense of the body.

**i. Mitochondria:** are rods shaped, cylindrical or globular cell organelles. Each mitochondrion has a double membranous structure enclosing the ground matrix. The inner membrane is produced into finger like processes called the cristae on which ribosomes are arranged. The matrix of the mitochondria contains enzymes necessary for the oxidation of food during cell respiration releasing energy in the form of ATP (Adenosine Tri Phosphate) molecules, which are stored inside the mitochondria. Therefore, mitochondria are called the power houses of the cell. They are the self replicating organelles, having DNA, RNA and ribosome to carry out protein synthesis.

### Functions:

1. Mitochondria are the sites of cellular respiration; ATP molecules are formed, stored and energy released as and when required.
2. Mitochondria make their own proteins and hence they are regarded as semi autonomous organelles.
3. They provide important intermediates for the synthesis of several biochemicals like chlorophyll, cytochromes, steroids etc.

**j. Plastids:** they are disc shaped or oval organelle which occurs in plant cells only. They are of three types:

Chloroplasts, chromoplasts and leucoplasts.

- i. **Chloroplasts:** are green colored plastids with chlorophyll as the photoreceptor pigment present in it. Each chloroplast has a double layered membrane envelop enclosing the matrix. A number of disc shaped grana are piled to form thylakoids found in the matrix. Photosynthetic pigment is present in the grana. The non thylakoid portion of the matrix is called stroma. It contains a number of enzymes involved in photosynthesis, and also its own ribosomes to manufacture its own proteins.
- ii. **Chromoplasts:** are the colored yellow, red or orange. They provide colour to flowers and fruits. It

some cases, the chloroplasts gradually get transformed into chromoplasts.

- iii. **Leucoplasts:** are colorless plastids which store food in the form of starch, fats and proteins.

**Functions:**

1. Chloroplasts perform the function of photosynthesis and therefore are involved in synthesis of food. Therefore these cell organelles can be considered the food factories.
2. Chloroplasts fix CO<sub>2</sub> and release O<sub>2</sub> during photosynthesis and maintain a healthy balance of the two gases in the environment.
3. Chromoplasts help in pollination by imparting color to flowers and in dispersal of seeds by coloring the fruits.
4. Leucoplasts help in the storage of food materials in the form of starch as in potato, fruit pulp etc; as fats in oil seeds of sunflower, flax etc., and as proteins in seeds such as peas and beans.

**k. Vacuole:** vacuoles are fluid filled membrane bound spaces present in the cell. Each vacuole is surrounded by a membrane called tonoplast. Plant cells have larger vacuole, centrally occupying nearly 50 – 70% of the cell volume and filled with cell sap. Cell sap contains mineral salts, sugars, amino acids, proteins etc soluble in water. In animal cells, the vacuoles are smaller in size, may contain ingested food material, therefore forming food vacuole.

**Functions:**

1. Vacuoles store mineral salts and nutrients.
2. They maintain proper osmotic pressure in the cell by keeping the cells turgid and rigid.
3. They help osmoregulation in animals such as amoeba and paramecium.

**l. Centrosome:** is a small protoplasmic structure present above the nucleus very near to the nuclear membrane. It does not have an outer limiting membrane around it. Centrosome is made of two small granules called the centrioles, which move to the opposite poles when the cell initiates cell division.

**Functions:**

1. They form spindles and help in the movement of chromosomes during cell division.
2. They form the basal bodies that give rise to cilia and flagella.

**12. Differentiate between plant cell and animal cell.**

	<b>Plant Cell</b>	<b>Animal Cell</b>
1	Comparatively larger in size	Usually smaller in size than the plant cell
2	Usually rectangular , polygonal or round cells	Varied shapes based on the function of the cell.
3	Cell wall made of cellulose is present	Cell wall is absent.

4	Centrally located large vacuole is present, filled with cell sap.	Many small vacuoles are present scattered in the cytoplasm
5	The components of the golgi apparatus are diffused and are called dictyosomes.	Golgi apparatus is well developed and present near the nucleus.
6	Centrosome is not seen in plant cell. Its function is carried out by the polar caps.	Centrosome is present, just above the nucleus, that takes part in formation of spindle fibres.
7	Plastids are present.	Plastids are absent.
8	The reserve food is stored as starch or oil.	The reserve food is stored as glycogen.

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